Nobel Prizes and the Emerging Gene Concept

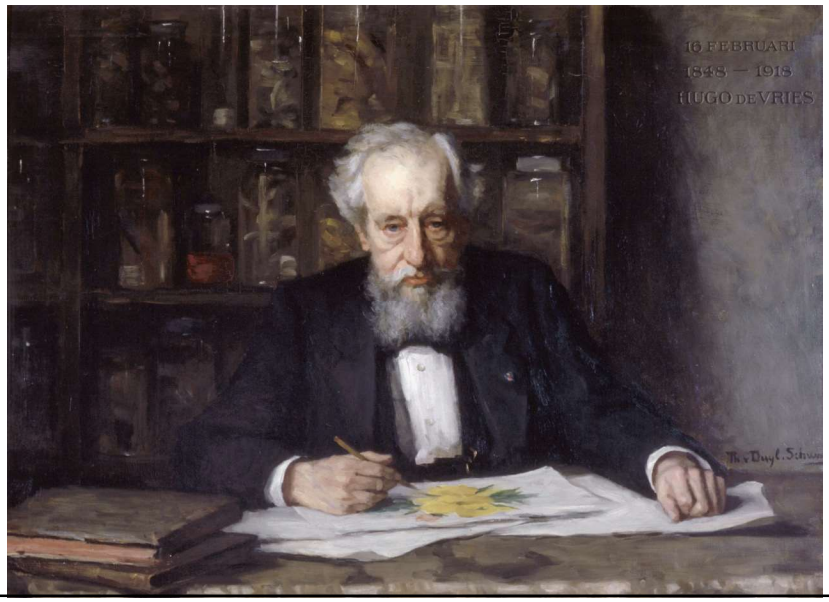
National Library of Medicine,
National Institutes of Health
February 13, 2023
Erling Norrby

1

A tribute to Gregor Mendel 200 years

2

Hugo de Vries (1848–1935) –
one of the three rediscoverers of heredity in 1900.
He coined the new word mutation



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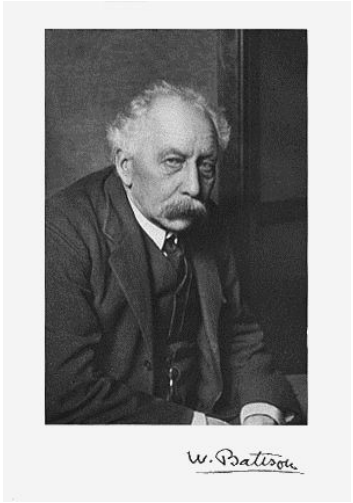
William Bateson (1861–1926) –
He renamed de Vries term “pangeny” to
“gene” – from greek *gonos* “offspring” 1909



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Friedrich Miescher
1844–1895

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Albrecht Kossel 1853–1927
Nobel Prize in Physiology or Medicine 1910

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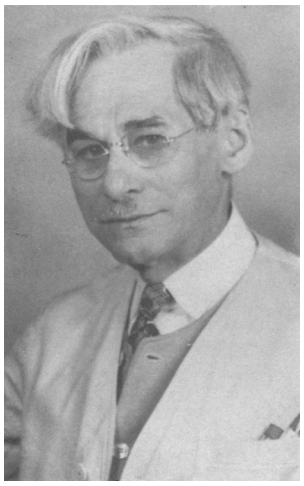
Phoebus Aaron Levene
1869–1940



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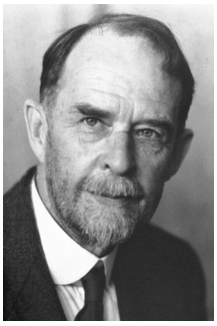
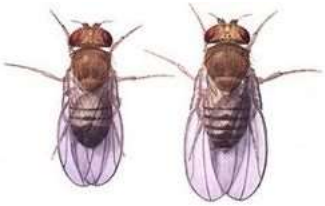
The Nobel Prize in Physiology or Medicine 1933



Thomas H. Morgan



for his discoveries concerning the role played by the chromosome in heredity

8

The Nobel Prize in Physiology or Medicine 1946

Hermann J. Muller

for the discovery of the production of mutations by means of X-ray irradiation

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"it would give us an utterly new angle from which to attack the gene problem. They (the viruses, my remark) are filterable, to some extent isolatable, can be handled in test tubes…It would be very rash to call these bodies genes, and yet at present we must confess that there is no distinction known between the gene and them. Hence we cannot categorically deny that perhaps we may be able to find genes in a mortar and cook them in a beaker after all."

Quote by Muller in 1920

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”Dear Comrade Stalin! As a scientist with confidence in the ultimate Bolshevik triumph throughout all possible spheres of human endeavor, I come to you with a matter of vital importance arising out of my own science – biology, and in particular genetics…”and towards the end of the very long letter he wrote: “Banishing false gods, man, organized under socialism, most boldly assumes the role of creator, conquering with Bolshevik enthusiasm even that most impregnable fortress that holds the Key to his own inner being.”

1935 Muller dedication to Stalin on account of his recent book *Out of the Night*

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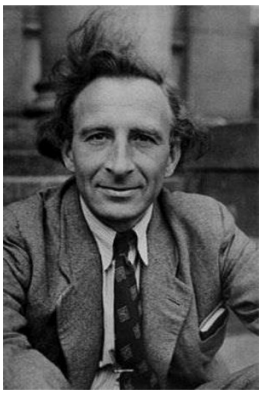
Niels Bohr, Max Born & Max Delbrück

12



Nikolay Timofeev-Ressovsky

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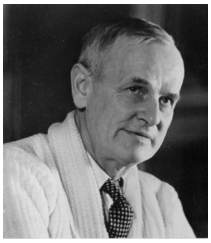
Einar Hammarsten
1889–1968



Torbjörn Caspersson
1910–1997

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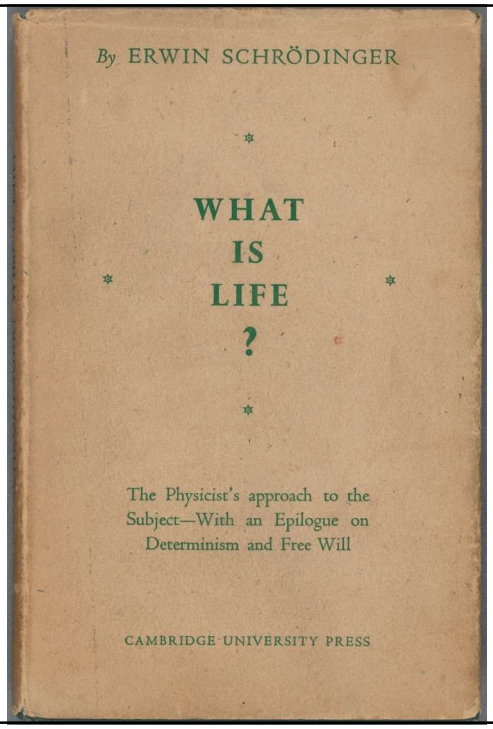

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The Nobel Prize in Chemistry 1946 shared

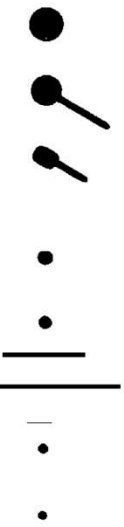
Wendell M. Stanley

for their preparation of enzymes and virus proteins in a pure form

17

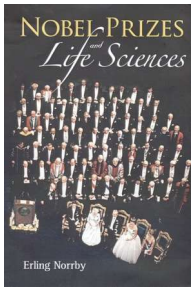
18

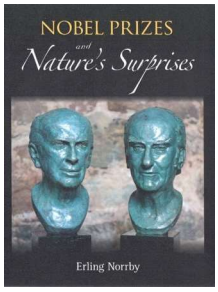
Rabies fixe	125
Influenza	115
Newcastle disease	115
Vesicular stomatitis	100
Staphylococcus bacteriophage	100
Fowl Plague	90
T_2 coli bacteriophage	60 × 80
Chicken tumor I	70
Equine encephalomyelitis	50
T_3 coli bacteriophage	45
Rabbit papilloma (Shope)	44
Pneumonia virus of mice	40
Tobacco mosaic and strains	15 × 280
Latent mosaic of potato	10 × 525
Gene (Muller's est. of max. size)	*20 × 125*
Southern bean mosaic	31
Rift valley fever	30
Tomato bushy stunt	26
Poliomyelitis (Lansing)	25

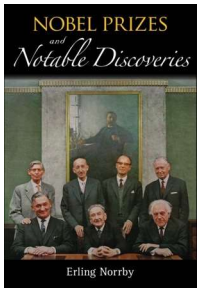


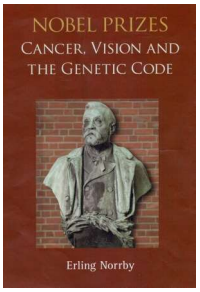
From Stanley's Nobel Lecture

19









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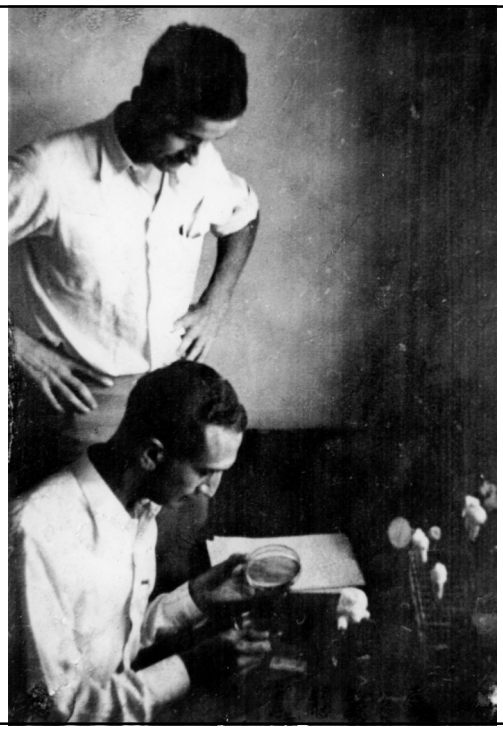
Felix d'Herelle, Pasteur Institute

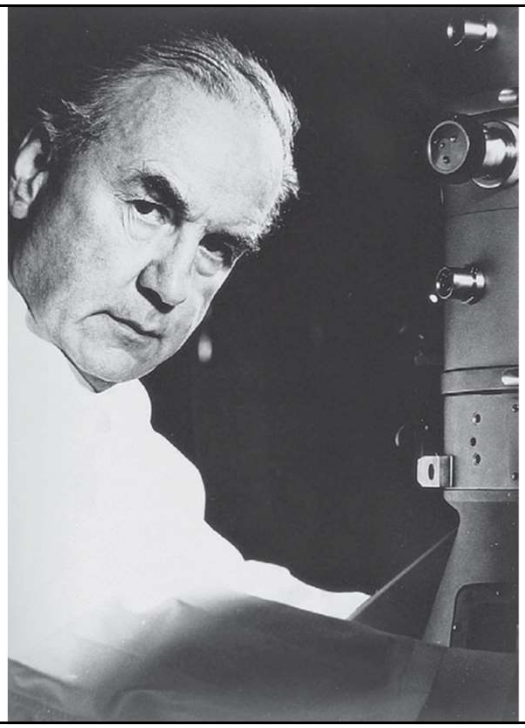
21



Max Delbrück &
Salvador Luria

22

Helmut Ruszka
(1908–1973)



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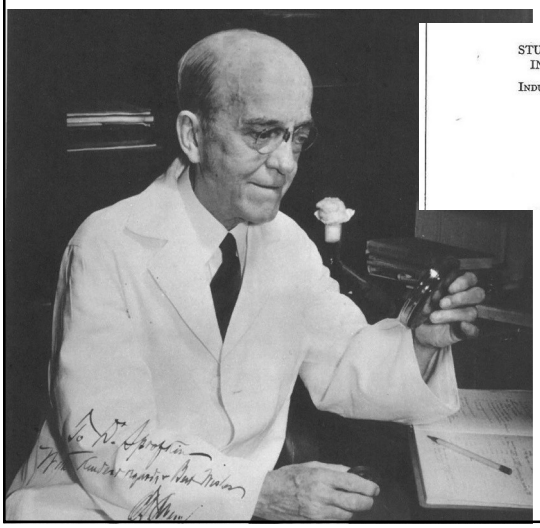
Oswald T. Avery
1877–1955



STUDIES ON THE CHEMICAL NATURE OF THE SUBSTANCE INDUCING TRANSFORMATION OF PNEUMOCOCCAL TYPES

INDUCTION OF TRANSFORMATION BY A DESOXYRIBONUCLEIC ACID FRACTION ISOLATED FROM PNEUMOCOCCUS TYPE III

BY OSWALD T. AVERY, M.D., COLIN M. MACLEOD, M.D., AND MACLYN MCCARTY,* M.D.

(*From the Hospital of The Rockefeller Institute for Medical Research*)

PLATE 1

(Received for publication, November 1, 1943)

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"Here is a change to which, if we are dealing with higher organisms, we should accord the status of genetic variation; and the substance inducing it – the gene in solution one is tempted to call it – appears to be a nucleic acid of the deoxyribose type. Whatever it be it is something which should be capable of complete description in terms of structural chemistry."

Henry Dale President's speech at RS 1944

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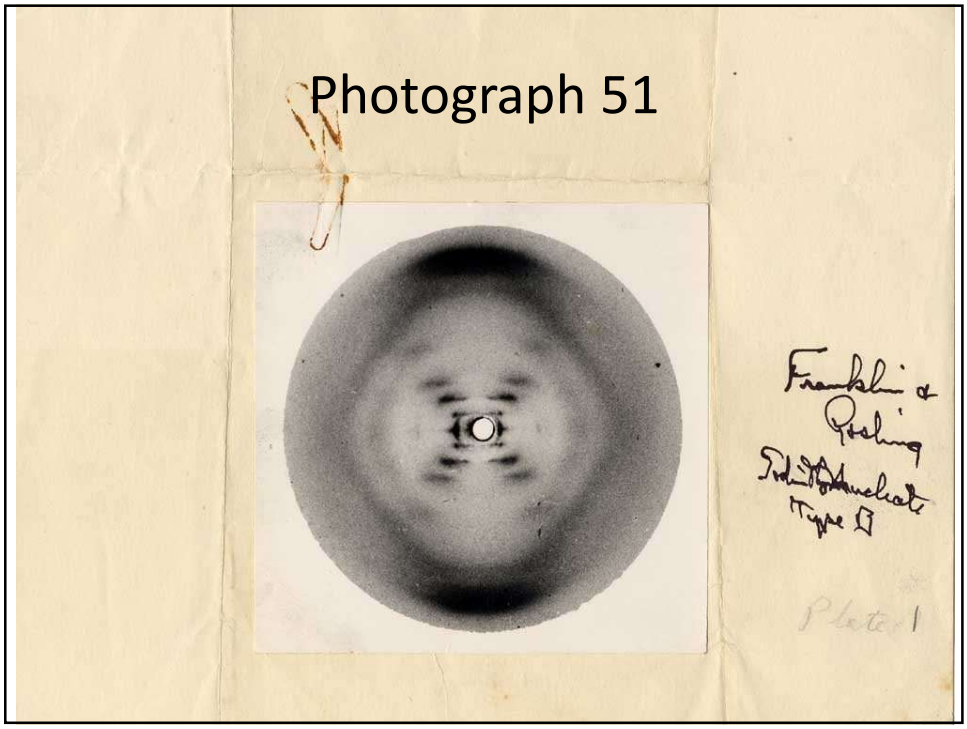
Alfred Hershey (1908–1997) Nobel Prize in Physiology or Medicine 1969 and Martha Chase (1927–2003)

27

Rosalind Franklin,
1920–1958

Maurice Wilkins
1916–2004

28



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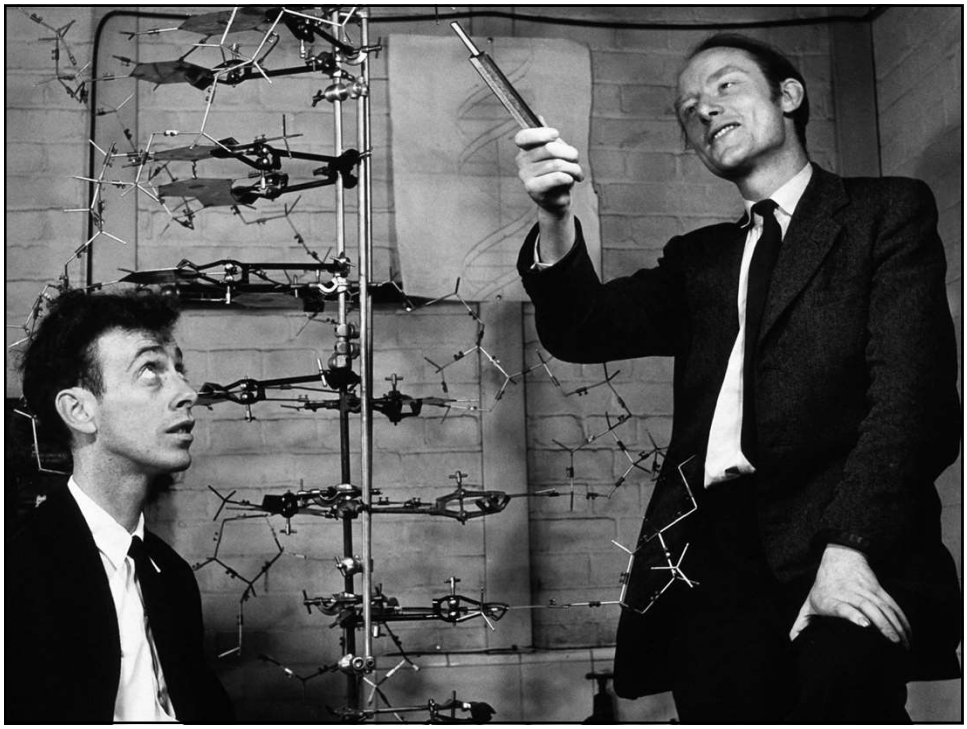
Aaron Klug's Nobel lecture 1982

"It was Rosalind Franklin who set me the example of tackling large and difficult problems. Had her life not been cut tragically short, she might well have stood in this place on an earlier occasion."

30



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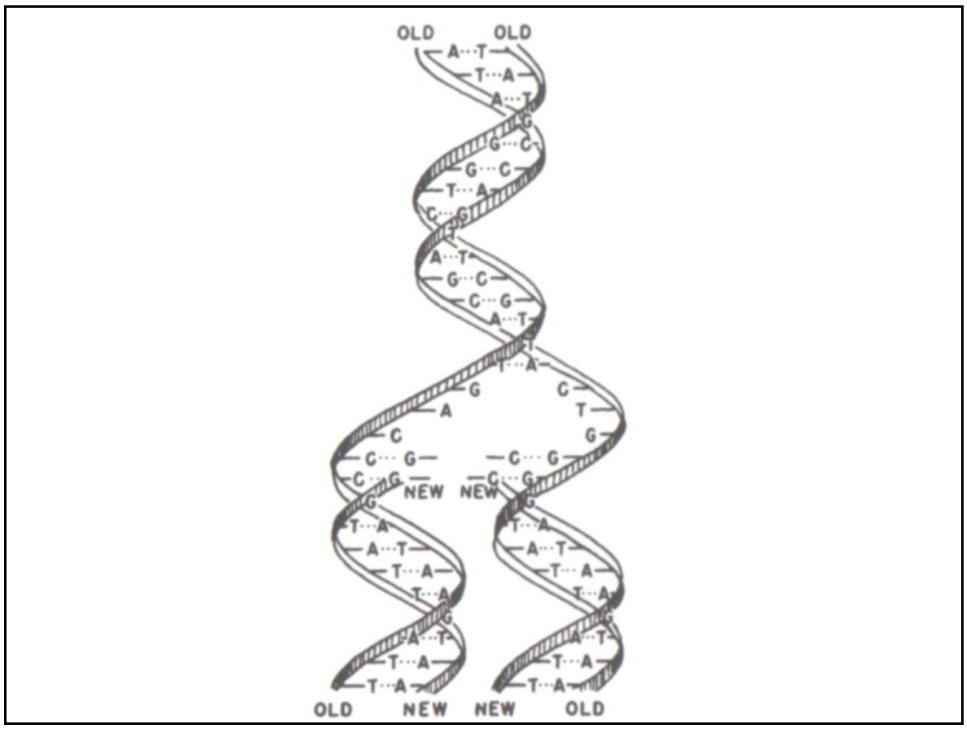

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Theorell's concluding comments

The independent amino acids do not show a tendency to display any kind of periodicity, but appear to be positioned without any rule after each other, however always in a given place. There are no reversals in position of related amino acids, like for example leucin and isoleucin….. Thus each insulin molecule should be exactly identical to all others (My italics). Earlier one has been reluctant to believe that protein molecules should be reproducible into the smallest detail. …..

But how would it be possible to conceptualize the synthesis of proteins? If there is no periodicity or other predetermined order (that) can be traced in the polypeptide chains that form proteins one would be forced to assume that the formation even of the simplest protein, like insulin, would require perhaps some 50 different absolutely specific enzymes to attach each individual amino acid, one at a time, until finally the chain is complete.

From a review of F. Sanger in 1953

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Alfred Gierer, Gerhard Schramm, Heinz Fraenkel-Conrat – discoverers of infectious RNA in TMV

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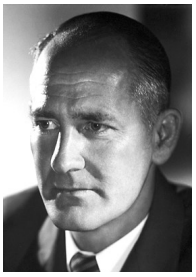
Nobel Prizes in Nucleic acid and Genetic research in the 1950s

Chemistry 1957
Lord Todd "for his work on nucleotides and nucleotide co-enzymes"



Medicine or Physiology 1958
George Wells Beadle & Edward Lawrie Tatum "for their discovery that genes act by regulating definite chemical events"

Medicine or Physiology 1958
Joshua Lederberg "for his discoveries concerning genetic recombination and the organization of the genetic material of bacteria"

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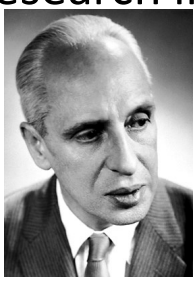
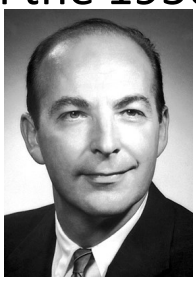
Nobel Prizes in Nucleic acid and Genetic research in the 1950s contd.





Medicine or Physiology 1959
Severo Ochoa & Arthur Kornberg "for their discovery of the mechanisms in the biological synthesis of ribonucleic acid and deoxyribonucleic acid"

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Chapter 8, Table. Nominations to Nobel Prizes in chemistry and physiology or medicine for the discovery of the structure of DNA.

Year	Chemistry nominee	Chemistry nominator	Physiology or medicine nominee	Physiology or medicine nominator
1960	Watson, Crick, Wilkins	W. Bragg, Cambridge	Crick, Watson Perutz, Crick	M. Stoker, Glasgow E. J. King, London
1961			Watson, Crick Wilkins, Watson, Crick	A. Szent-Gyorgyi, Woods Hole G. Beadle, Pasadena R. M Herriott, Baltimore
1962	Watson, Crick Watson, Crick, Wilkins	D. H. Campbell, Pasadena W. H. Stein, New York H. C. Urey, La Jolla J. Cockcroft, Cambridge S. Moore, New York J. Monod, Paris	Watson, Crick Watson, Crick, Wilkins Crick, Watson, Wilkins (Benzer, S.), Crick (Benzer, S.), Crick	Gilbert H. Mudge, Baltimore G. Beadle, Pasadena C. H. Stuart-Harris, Sheffield P.J. Gaillard, Leiden F. H. Sobels, Leiden

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Crick, Watson and Wilkins at Prize ceremony 1962

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Nobel Prize Lectures in Physiology or Medicine 1962

- Wilkins, The Molecular Configuration of Nucleic Acids
- Watson, The Involvement of RNA in the Synthesis of Proteins
- Crick, On the Genetic Code

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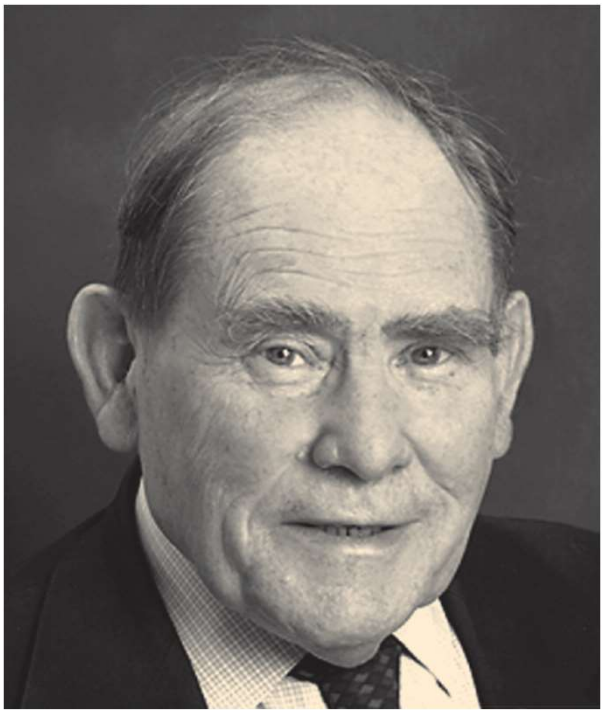
Seymor Benzer: a) molecular phage genetics b) behaviour genetics

40

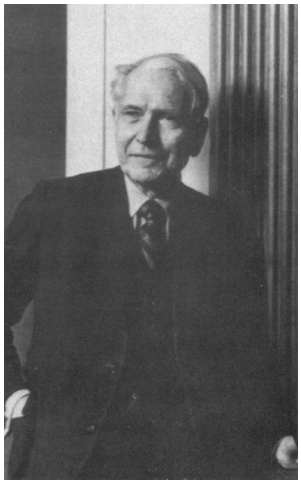


Sydney Brenner Shared Nobel Prize in physiology or medicine 2002

” for their discoveries concerning genetic regulation of organ development and programmed cell death”

41

Erwin Chargaff
1905–2002



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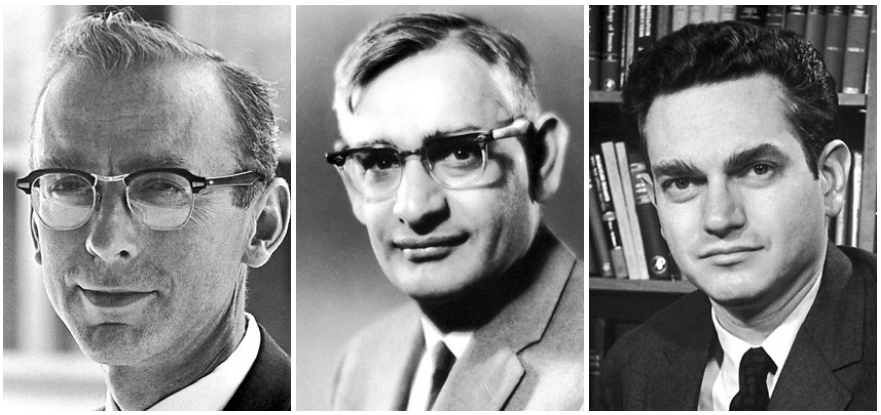
The Nobel Prize in Physiology or Medicine 1968

"for their interpretation of the genetic code and its function in protein synthesis."

Robert W. Holley, H. Gobind Khorana & Marshall W. Nirenberg



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GCA GCC GCG GCU	AGA AGG CGA CGC CGG CGU	GAC GAU	AAC AAU	UGC UGU	GAA GAG	CAA CAG	GGA GGC GGG GGU	CAC CAU	AUA AUC AUU	
Ala	Arg	Asp	Asn	Cys	Glu	Gln	Gly	His	Ile	
A	R	D	N	C	E	Q	G	H	I	
UUA UUG CUA CUC CUG CUU	AAA AAG	AUG	UUC UUU	CCA CCC CCG CCU	AGC AGU UCA UCC UCG UCU	ACA ACC ACG ACU	UGG	UAC UAU	GUA GUC GUG GUU	UAA UAG UGA
Leu	Lys	Met	Phe	Pro	Ser	Thr	Trp	Tyr	Val	stop
L	K	M	F	P	S	T	W	Y	V	

Figure 6–50. Molecular Biology of the Cell, 4th Edition.

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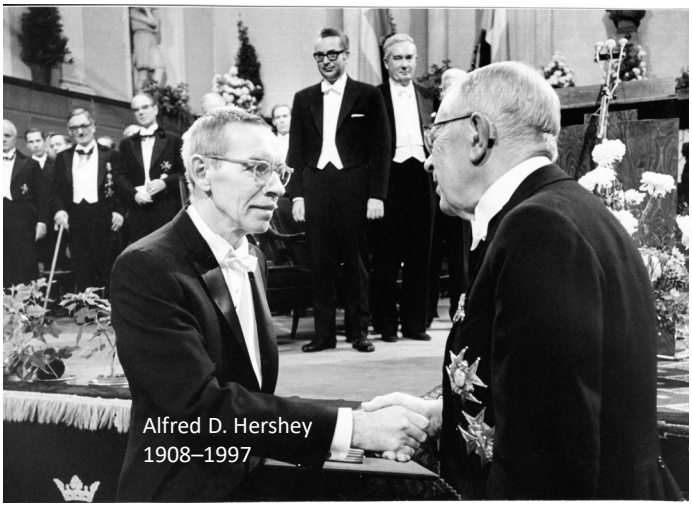
The Nobel Prize in Physiology or Medicine 1969
"for their discoveries concerning the replication mechanism and the genetic structure of viruses."

45

The Nobel Prize in Physiology or Medicine 1969
"for their discoveries concerning the replication mechanism and the genetic structure of viruses."



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The Nobel Prize in Physiology or Medicine 1969
"for their discoveries concerning the replication mechanism and the genetic structure of viruses."
Salvador E. Luria
1912–1991

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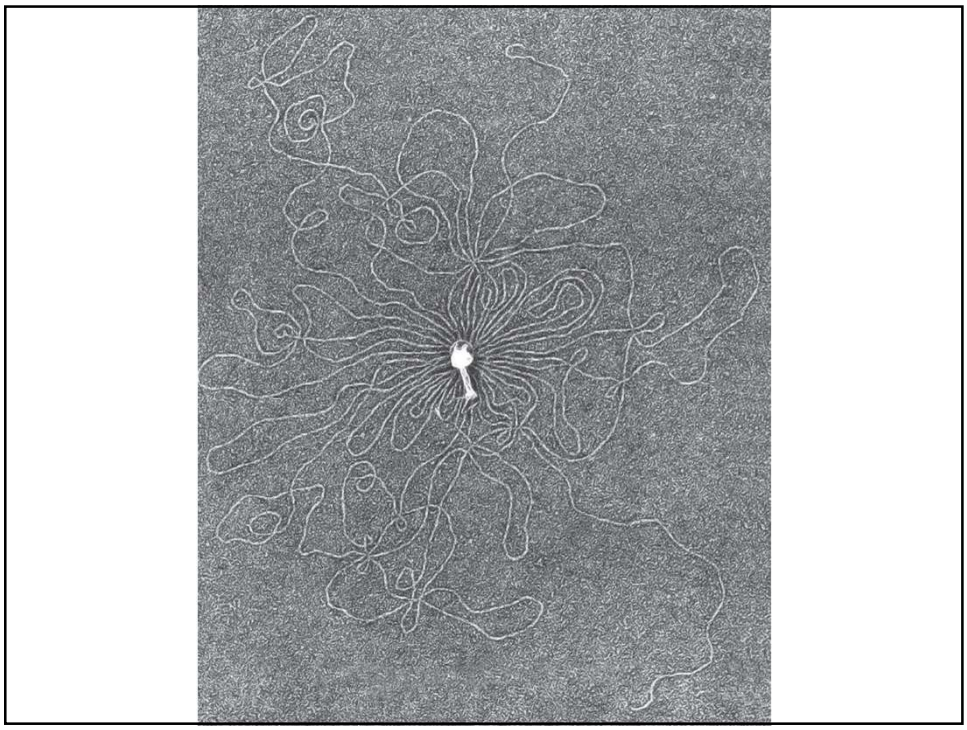

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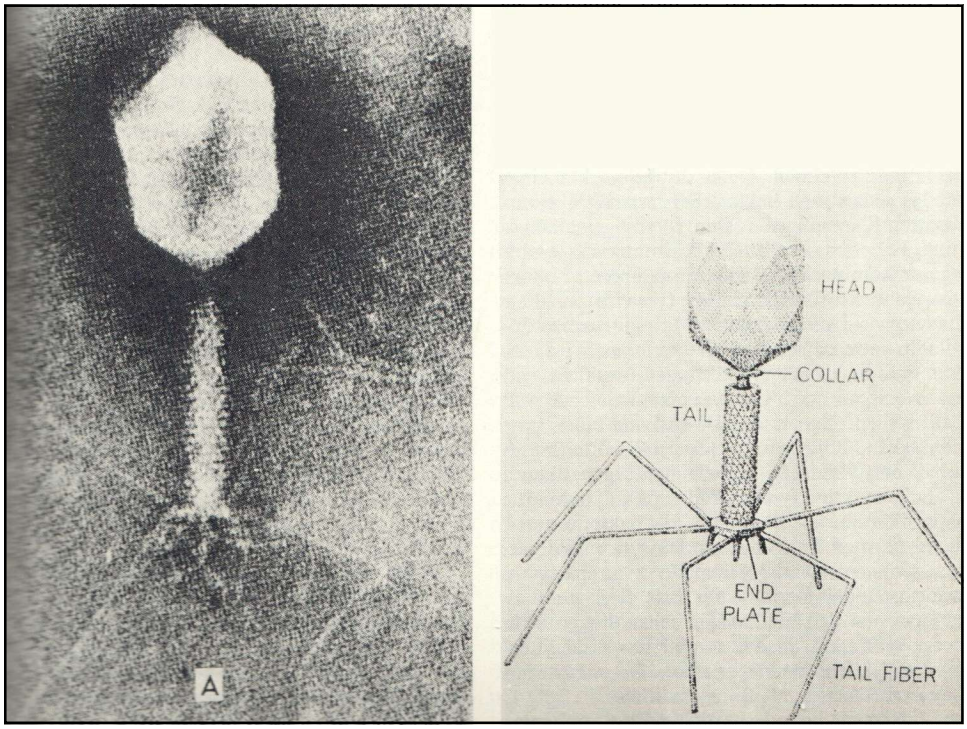

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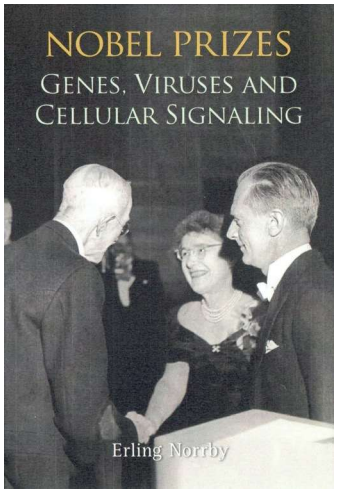
Later we have learnt that it may not be meaningful to define the average size of a gene. As is currently known their size varies enormously. This variation ranges from the 76 base pairs that constitute one kind of transfer RNA to the muscle protein titin (an acronym originating from the word titanic protein) specified by a gene represented by more than 100,000 base pairs.

50


NOBEL PRIZES
GENES, VIRUSES AND
CELLULAR SIGNALING
Erling Norrby

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